SUPPORT ELEMENT

Background Information

The present invention is directed to a support element for maintaining clearance between a fuel injection line and a fuel injector inserted into a cylinder head of an internal combustion engine according to the definition of the species in the main claim.

An attachment device for attaching a fuel injector to an intake manifold, in which the fuel injector is axially fixed to the fuel distribution line and to a plug nipple via an attachment element designed as a U-shaped securing clamp having two legs which are flexible in the radial direction, is known heretofore from DE 29 26 490 A1. When mounted, the securing clamp extends through corresponding notches in the plug nipple and can be clicked into place in a recess designed as an annular groove in a connector piece of the fuel injector. The axial play between the notches and the securing clamp and between the annular groove and the securing clamp is to be kept to a minimum, so that the fuel injector may be fixed precisely in place without strain on the seal.

The disadvantage of the known attachment device disclosed in DE 29 26 490 A1 is in particular the fact that the various holding components exert strain upon the fuel injector. The resulting flux of force in the fuel injector results in deformations and thereby in changes in the lift and even seizure of the valve needle, and also results in pressure load or bending load on the housing components, which as a general rule have thin walls and are welded to one another at various points. Moreover, every attachment means, e.g., a contact

collar, increases the radial dimension of the fuel injector, which in turn means more space is required for installation.

Advantages of the Invention

By contrast, the support element according to the present invention for a fuel injector having the characterizing features set forth in the main claim has the advantage that the fuel distribution line rests against the fuel injector via the support element according to the present invention without any radial force being exerted, which means there is no damage to the fuel injector or to the fuel distribution line connector. Due to appropriately designed brackets and clips, the support element ensures that the hold-down force of the fuel distribution line is transferred onto the fuel injector, and also allows fixing to be flexible so that tolerances and offsets are compensated for.

Advantageous further refinements of and improvements on the support element indicated in the main claim are achievable via the measures set forth in the dependent claims.

In particular it is advantageous that the support element may be manufactured in a straightforward manner by stamping sheet metal. It may also be manufactured via deep-drawing and stamping.

It is advantageous that in the case of the support element according to the present invention there are no screws or tensioned claws for attaching the fuel injector to the front of the cylinder head.

It is advantageous that stamped recesses which are easy to produce ensure that the support element is securely fixed to the fuel injector and that the fuel distribution line is supported in a simple manner.

The various clip shapes may be advantageously designed so that greater or lesser elastic and plastic deformation allows the support between the fuel distribution line and the fuel injector to be optimized in accordance with the installation situation.

Drawing

Exemplary embodiments of the present invention are schematically illustrated in the drawing and explained in greater detail in the description.

Figure 1A-D shows various schematic views of a first exemplary embodiment of a support element according to the present invention for a fuel injector;

Figure 2 shows a schematic perspective view of the second exemplary embodiment of a support element according to the present invention; and

Figure 3 shows a schematic perspective view of a third exemplary embodiment of a support element according to the present invention.

Description of the Exemplary Embodiments

Figures 1A through 1D show various schematic views of a first exemplary embodiment of a support element 3 according to the present invention for fixing a fuel injector 1 in cylinder head 12 of an internal combustion engine and for connecting fuel injector 1 to fuel distribution line 2.

Figure 1A schematically shows, in a partial-section perspective view, how support element 3 along with fuel injector 1 are installed.

Fuel injector 1 is in the form of direct-injection fuel injector 1, which may be used in a valve receptacle of

cylinder head 12 to directly inject fuel into a combustion chamber of an in particular explosion-type spark-ignition internal combustion engine (not shown). The valve receptacle may also be provided on a mounting connector piece of an intake manifold (not shown). Fuel injector 1 has, on feed end 4, a plug connection to a receptacle connector piece of fuel distribution line 2, which is sealed by seal 5 between fuel distribution line 2 and inflow connector element 6 of fuel injector 1. Fuel injector 1 has electrical terminal 7 for creating electrical contact for actuation of fuel injector 1.

To ensure that clearance is maintained between fuel injector 1 and fuel distribution line 2 without radial force being exerted, support element 3 is provided according to the present invention. Support element 3 includes clamp 8, which rests against shoulder 9 of fuel injector 1 and is supported by shoulder 10 of fuel distribution line 2. Clamp 8 has a slit in the area of electrical connector 7 of fuel injector 1, to facilitate assembly.

Figure 1B shows how clamp 8 is placed on fuel injector 1 and rests against shoulder 9.

As shown in particular in Figure 1D, in the first exemplary embodiment two clips 11 and two brackets 18 are provided on clamp 8 and ensure that fuel distribution line 2 is flexibly braced against fuel injector 1. Clips 11 are responsible for a radial clamping effect and brackets 18 are responsible for axial elasticity. Clips 11 rest against shoulder 9 of fuel injector 1, and brackets 18 rest against shoulder 10 of fuel distribution line 2.

Due to their shape and arrangement on clamp 8, brackets 18 are designed in such a way that they are plastically-elastically deformable under axial load and as a result transfer axial force onto fuel injector 1.

Figure 1C shows a top view of the first exemplary embodiment of support element 3 according to the present invention, in mounted position on fuel injector 1. To prevent support element 3 from shifting due to the axial force exerted by fuel distribution line 2, which would result in strain on fuel injector 1 in the cylinder head and bending of fuel injector 1 resulting in improper functioning, e.g., a stuck valve needle of fuel injector 1, support element 3 is not round but rather has a roughly rectangular or quadrangular cross section. In addition, edges 16, which form the ends of clamp 8 on both sides of slit 15, are folded radially inward toward fuel injector 1. As a result, edges 16 rest against fuel injector 1 along their entire axial length, thus keeping support element 3 from slipping.

When support element 3 has been installed, electrical connector 7 of fuel injector 1 is in the area of slit 15.

In Figure 2, a second exemplary embodiment of support element 3 according to the present invention is shown. The support element has clips 11 having different shapes, which are connected to clamp 8. In the exemplary embodiment, two clips 11b opposite one another are tongue-shaped, and a third clip 11 is roughly onion-shaped. A reverse arrangement with two onion-shaped clips 11a and one tongue-shaped clip 11b is also feasible. Recess 17 in clip 11a ensures that clip 11a has high elasticity and thus greater tolerance with regard to stress. Edges 16 may be designed as shown in Figures 1A through D.

Figure 3 shows a third exemplary embodiment of support element 3 according to the present invention. It has clips 11 which in terms of shape constitute a combination of tongue-shaped clips 11b and onion-shaped clip 11a of the second exemplary embodiment described above. The shape shown is easier to manufacture, but nonetheless has high elasticity and

flexibility for offsetting radial and axial loads. Edges 16 may also be designed as shown in Figures 1A-D.

Because the components are flexibly braced against one another, axial loads exerted by fuel distribution line 2, and also manufacturing tolerances and changes in length due to heating when the internal combustion engine is in operation, may be offset.

The present invention is not limited to the exemplary embodiments shown, and for example may also be used for fuel injectors 1 for injecting fuel into the combustion chamber of a compression-ignition internal combustion engine. In particular, support element 3 shown in the figures may also be mounted in reverse position so that brackets 18 rest against shoulder 9 of fuel injector 1 instead of against shoulder 10 of fuel distribution line 2. All features of the present invention may be combined with one another as desired.